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STATUS STUDY OF SCHOOLS TEACHING EARTH AND SPACE SCIENCE IN PENNSYLVANIA 1965-66.

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PENNSYLVANIA STATE DEPT. OF PUBLIC INSTRUCTION

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DESCRIPTORS- *CURRICULUM, *EARTH SCIENCE, *SECONDARY SCHOOL SCIENCE, ASTRONOMY, COURSE CONTENT, GENERAL SCIENCE, STUDENT ENROLLMENT, SCIENCE FACILITIES, PENNSYLVANIA,

THE STATUS OF EARTH AND SPACE SCIENCE COURSES IN PENNSYLVANIA WAS INVESTIGATED. OF 461 QUESTIONNAIRES SENT TO SECONDARY SCHOOLS OFFERING EARTH AND SPACE SCIENCE, 172 WERE RETURNED. TABLES AND PERCENTAGES WERE USED TO INTERPRET FINDINGS. MORE THAN 87 PERCENT OF THE RESPONDENTS HAD BEEN TEACHING EARTH AND SPACE SCIENCE FOR LESS THAN FIVE YEARS - FOUR YEARS WAS THE MOST FREQUENTLY MENTIONED LENGTH OF TIME. FORTY-ONE SCHOOLS HAD LESS THAN 100, 42 HAD 100 TO 200, AND 26 HAD MORE THAN 200 STUDENTS ENROLLED IN EARTH AND SPACE SCIENCE PROGRAMS. EIGHTEEN SCHOOLS REPORTED TEACHING ONE SECTION OF EARTH AND SPACE SCIENCE, AN ADDITIONAL 18 TAUGHT TWO SECTIONS, AND 54 TAUGHT THREE OR MORE SECTIONS. THE RESPONDENTS LISTED 213 TEACHERS INVOLVED IN TEACHING AT LEAST ONE COURSE IN EARTH AND SPACE SCIENCE. THE MOST FREQUENTLY MENTIONED TEXT USED BY SCHOOLS WAS "THE WORLD WE LIVE IN" BY NAMOWITZ AND STONE. ONE HUNDRED CLASSES OF EARTH AND SPACE SCIENCE WERE LABORATORY-CENTERED, WHILE 64 INDICATED A NONLABORATORY CENTERED PROGRAM. OTHER INFORMATION INCLUDED IN THE SURVEY WAS RELATED TO FIELD TRIPS, THE USE OF OBSERVATORIES, THE AVAILABILITY OF TELESCOPES AND WEATHER STATIONS, AND PROBLEMS ENCOUNTERED IN THE TEACHING OF EARTH SCIENCE. (AG)

Commonwealth of Pennsylvania

January 11, 1966

SUBJECT: Status of the Pennsylvania Earth and Space Science Program

FROM: Dr. John E. Kosoloski
Director, Education Evaluation
Office of Evaluation

The Office of Evaluation has compiled a report titled "Status Study of Schools Teaching Earth and Space Science in Pennsylvania 1965-66". The report was prepared by Dr. Sydney Grobman, Education Evaluation Advisor, and is being made available to teachers who participated in the 1965 survey.

Although the survey did not include all schools teaching Earth and Space Science, it does indicate certain trends in the growth of the Pennsylvania Program.

STATUS STUDY OF SCHOOLS TEACHING

EARTH AND SPACE SCIENCE IN PENNSYLVANIA 1965-66

Office of School and Program Evaluation
DEPARTMENT OF PUBLIC INSTRUCTION
Harrisburg

January - 1966

for determining the
the proportion of
the ability to
with biology. In addition, the
recent information derived
physics, geophysics, astronomy, and

Earth and Space Science Course Tested

In May, 1963, the Pennsylvania
attempted a testing project that would
grade students receiving instruction under
types of groups tested involved (1) students receiving instruction for one year in a course specifically labeled Earth and Space Science, and (2) students who for one year were enrolled in a regular General Science program. It was understood that the two courses would naturally cover topics in physics, chemistry, and other sciences that would conceivably overlap. Nineteen schools were involved as a result of a random sampling

The test materials were prepared
ordinator of Earth and Space
the Pennsylvania Earth and Space
to a committee of teachers of Earth and
test material was subsequently
reliability and item validity.

As the high school
the mean score of the students
was 30, and the mean score of the

The results showed
Space Science

the area tested. Further analysis did not indicate in one single item where the general science group scored significantly higher than the Earth and Space Science group. However, in the Earth Science section of the test the Earth and Space Science students scored 21% higher than the General Science students, but only 11.5% higher in the Space Science section. From this result one could infer that the Earth-Space Science students were more alert to the Earth Science concepts as compared to the Space Science concepts.

The concepts that appeared to be most completely known dealt with the following topics:

earth changes in formation
meander and oxbow lakes
location of common earthquake faults
ages of rivers
igneous rocks
vertically developed clouds
overcast rain
cirrus clouds
planet revolutions
planet location
planet temperature

The following topics appeared to be least understood:

characteristics of sandstone
definition of rocks
fault by tension
stratus clouds
air composition
distance and size of solar system
gravity

Table 2 presents a comparison of the two groups on an individual Earth Science concept, with the particular question briefly indicated. The data are recorded in per cent of students obtaining the correct answer.

TABLE II

Comparison of General Science and Earth and Space Science Classes on the Results of the Earth and Space Science Test (ERS Form A)

EARTH SCIENCE

Item Content	General Science	Earth Science	Difference General Science minus Earth Science	Level of Significance*
Earth Changes	90.2	88.3	1.9	NS
Age of earth	54.0	71.7	-17.7	S, ES
Man's age to earth's	32.1	29.7	2.4	NS
Man's evolution	42.3	54.1	-11.8	S, ES
Earth's crust	12.6	24.4	-11.8	S, ES
Mohorovicic discontinuity	32.1	62.2	-30.1	S, ES
Rejuvenated streams	13.5	32.2	-18.7	S, ES
Oxbow lakes	16.3	77.4	-61.1	S, ES
Pleistocene, Glaciers	11.6	25.4	-13.8	S, ES
Location of deserts	34.4	50.5	-16.1	S, ES
Earthquake locations	54.4	68.2	-13.8	S, ES
Stages of rivers	53.0	80.2	-27.2	S, ES
Salt domes, Oil	20.5	26.2	5.7	NS
Sedimentary rocks	12.1	32.5	-20.4	S, ES
Silurian, Devonian periods	22.3	31.5	-9.2	S, ES

continued on next page

Data are in per cent of students obtaining the correct answer.
Sections of test with Item Content briefly indicated.
- sign on difference column indicates Earth Science group scored higher.
* NS indicates no significant difference
S, ES indicates significance favoring the Earth Science group at the .05 level

TABLE II (continued)

Item Content	General Science	Earth Science	Difference General Science minus Earth Science	Level of Significance*
Metamorphic, slate	27.4	36.7	-9.3	S, ES
Intrusive igneous	34.0	52.3	-18.3	S, ES
Limestone	42.8	57.6	-14.8	S, ES
Dissolving of limestone	39.1	44.5	5.4	NS
Sandstone	14.4	7.8	6.6	NS
Igneous rocks	69.8	84.5	-14.7	S, ES
A sill	16.7	58.0	-41.3	S, ES
Shale	51.6	63.6	-12.0	S, ES
Slate	35.8	64.7	-28.9	S, ES
Basalt	35.3	31.5	3.8	NS
Limestone and marble	34.9	44.2	-9.3	S, ES
Definition of rocks	24.7	25.1	.4	NS
Porphoritic	30.2	26.5	3.7	NS
Anticline	14.9	65.4	-50.5	S, ES
Syncline	20.0	65.0	-45.0	S, ES
Igneous activity	20.9	52.3	-31.4	S, ES

continued on next page

Data are in per cent of students obtaining the correct answer.
Sections of test with Item Content briefly indicated.
- sign on difference column indicates Earth Science group scored higher.
* NS indicates no significant difference
S, ES indicates significance favoring the Earth Science group at the .05 level

TABLE II (continued)

Item Content	General Science	Earth Science	Difference General Science minus Earth Science	Level of Significance*
Fault by compression	31.6	42.8	-11.2	S, ES
Angular unconformity	26.5	44.5	-18.0	S, ES
Fault by tension	17.2	33.2	-16.0	S, ES
Marble	45.6	45.9	.3	NS
Metamorphous rock	48.8	56.2	7.4	NS
Limestone	23.3	42.1	-18.8	S, ES
Igneous intrusions	20.9	20.5	.4	NS
Fossils	45.6	55.5	-9.9	S, ES
SPACE SCIENCE				
General weather	39.5	51.9	-12.4	S, ES
Stratus clouds	27.9	22.3	5.6	NS
Vertical clouds	66.0	73.5	7.5	NS
Overcast, rain	64.7	73.5	8.8	NS
Cirrus clouds	68.8	74.6	5.8	NS
Altocumulus clouds	44.2	55.8	-11.6	S, ES
Altostratus clouds	41.4	51.9	-10.5	S, ES
Air composition	9.8	11.0	1.2	NS

continued on next page

Data are in per cent of students obtaining the correct answer.
Sections of test with Item Content briefly indicated.
- sign on difference column indicates Earth Science group scored higher.
* NS indicates no significant difference
  S, ES indicates significance favoring the Earth Science group at the .05 level

TABLE II (continued)

Item Content	General Science	Earth Science	Difference General Science minus Earth Science	Level of Significance*
Weightlessness	19.1	32.5	-13.4	S, ES
Mass and gravity	19.5	29.0	-9.5	S, ES
Earth, sun relations	21.9	16.6	5.3	NS
Gravity	20.9	20.9	0	NS
Observation of planets	43.7	45.2	1.5	NS
Planet revolutions	70.2	76.0	5.8	NS
Planet size	38.1	38.5	.4	NS
Specific gravity	31.2	24.4	6.8	NS
Planet location	70.2	72.1	1.9	NS
Rocket landing	58.1	64.0	5.9	NS
Space distance	8.8	13.1	4.3	NS
Space travel	67.0	73.9	6.9	NS

Data are in per cent of students obtaining the correct answer.
Sections of test with Item Content briefly indicated.
- sign on difference column indicates Earth Science group scored higher.
* NS indicates no significant difference
S, ES indicates significance favoring the Earth Science group at the .05 level

The 1965-66 Survey of Earth and Space Science Courses

Now that three years have passed since the initial survey, it seems prudent to pause and reflect the status of this program as it is currently being conducted.

A questionnaire (Appendix A) was developed by the Coordinator of Earth and Space Sciences at the Department of Public Instruction. This survey instrument was modified after review by the professional staff of the Office of Evaluation. The final instrument was duplicated and sent to 461 schools reported teaching Earth and Space Science in the 1963 survey. A cover letter, soliciting the cooperation of the participants, accompanied each questionnaire mailed.

One hundred seventy-two (37.4 per cent) completed and returned the survey instrument. While it is not safe to make assumptions regarding the completeness of the sample, or its representative nature, the sampling is presented to supply the information requested by school systems, as well as providing a basis of comparison for the programs currently organized.

Number of Years Earth and Space Science in Schools

For convenience, data concerning the number of years that Earth and Space Science has been taught is shown in Table III.

TABLE III

NUMBER OF YEARS EARTH AND SPACE SCIENCE HAS BEEN TAUGHT IN PENNSYLVANIA SECONDARY SCHOOLS AS REPORTED IN 1965

Number Years Taught	Number Schools Reporting	Per Cent of Schools Reporting
1	9	7.6
2	16	13.6
3	29	24.6
4	31	26.2
5	18	15.2
6	6	5.1
7	3	2.5
8	4	3.4
9	0	0.0
10	2	1.8
	Total 118	100.0%

More than eighty-seven per cent of the respondents have been teaching Earth and Space Science for five or less years, with four years being the most frequently mentioned length of time. Fifteen schools (12.8 per cent) offered the Earth and Space Science course for a period of six to ten years. None of the districts reported teaching the course more than ten years ago.

Grade Level Earth and Space Science is Taught

Earth and Space Science was generally taught in the ninth grade. Seventy-one (44.5 per cent) of the schools reported this practice. Table IV provides a breakdown of the number of schools teaching the course in grades seven through twelve.

TABLE IV

NUMBER OF SCHOOLS REPORTING
EARTH AND SPACE SCIENCE PROGRAMS
THROUGH GRADES SEVEN TO TWELVE

Grade Level	Number of Schools Reporting	Per Cent of Schools Reporting
7	15	9.5
8	21	13.2
9	71	44.5
10	13	8.2
11	17	10.2
12	23	14.4
	160	100.0%

Number of Students Enrolled in Earth and Space Programs

Table V reveals that forty-one (37.5 per cent) schools had less than one hundred students enrolled in an Earth and Space program. Forty-two (38.4 per cent) schools had enrollments of one hundred to two hundred pupils. Twenty-six (24.1 per cent) reported enrollments of more than two hundred students in Earth and Space Science programs.

TABLE V

NUMBER OF STUDENTS ENROLLED IN EARTH AND SPACE SCIENCE PROGRAMS AS REPORTED IN 1965

Number of Students Enrolled	Number of Schools Reporting	Per Cent of Schools Reporting
0-99	41	37.5
100-200	42	38.4
201-500	20	18.6
Over 500	6	5.5
	Total 106	100.0%

Eighteen (15.7 per cent) schools reported teaching one section of Earth and Space Science, while an additional eighteen taught two sections. Seventeen (14.9 per cent) mentioned three sections; eleven (9.7 per cent) reported four sections; fifteen (13.2 per cent) recorded five sections; and an additional eleven (9.7 per cent) listed six sections scheduled. Twenty-four (21.1 per cent) schools had six or more classes organized. The complete tabulation of the number of sections in Earth and Space Science appears in Table VI.

TABLE VI

NUMBER OF SECTIONS OF EARTH AND SPACE SCIENCE REPORTED AS SCHEDULED BY PARTICIPATING SCHOOLS

Number of Sections Organized	Number of Schools Reporting	Per Cent of Schools Reporting
1	18	15.7
2	18	15.7
3	17	14.9
4	11	9.7
5	15	13.2
6	11	9.7
7	2	1.7
8	0	0.0
9	1	0.9
10 or more	21	18.4
	Total 114	100.0%

Teacher Personnel Involved in Earth and Space Science Programs

The one hundred seventy-two respondents listed two hundred thirteen teachers involved in teaching at least one course in Earth and Space Science. Another area of the survey instrument asked the respondents to report on certified personnel teaching in this area. One hundred twenty-eight (77.6 per cent) teachers were reported certified from a total of one hundred sixty-five personnel listed in this section of the questionnaire.

Textbooks Used to Teach Earth Space Science Programs

The most frequently mentioned text used by schools engaging in an Earth and Space Science course was "The World We Live In" reported by forty-eight schools. "Modern Earth Science" was the second most widely used text, being employed by twenty-eight schools. Other texts reported in use by ten or more schools were: (1) Earth Science (Holt and Co.), (2) Modern Space Science, and (3) Earth and Space Science. A complete listing follows:

TABLE VII

TEXTBOOKS USED BY REPORTING SCHOOLS
TEACHING A COURSE IN EARTH AND SPACE SCIENCE

Rank	Title	Number Reporting
1	The World We Live In (Namowitz and Stone)	48
2	Modern Earth Science (Ramsey and Burchley)	28
3.5	Earth Science (Holt and Co.)	15
3.5	Modern Space Science (Trinklein and Huffer)	15
5	Earth and Space Science (Fletcher and Wolfe)	12
6	Earth Science (Van Nostrand)	8
7	Basic Earth Science (Singer - 1963)	6
8	Mastering Earth Science (Oxford Review Book)	5
9	Physical World (Harcourt and Brace)	4
10.5	Selected Chapters in Science Problems (Beauchamp)	2

TABLE VII (Continued)

Rank	Title	Number Reporting
10.5	Facing Tomorrow with Science	2
19	Science in Today's World	1
19	Science for Your Needs	1
19	Science: A Search for Evidence	1
19	You and Your Resources	1
19	Science Problems	1
19	Science in Daily Life	1
19	The Earth and Its Resources	1
19	Physical Geology (Leet)	1
19	Astronomy (Baker)	1
19	Science and Your Future (Schneider)	1
19	Physical Science for Progress (Polla and Wood)	1
19	Special Observation Manual for Astronomy (Beauchamp)	1
19	Point to the Stars (Joseph and Lippincott)	1
19	Discovering the World of Science	1
19	Science in the Universe	1

Laboratory Facilities, Field Trips and Equipment

One hundred (61.0 per cent) classes of Earth and Space Science were laboratory centered; while sixty-four (39.0 per cent) indicated a non-laboratory centered program.

Thirty-eight (29.4 per cent) schools did not utilize any laboratories as part of their program. Sixty (46.5 per cent) schools had one laboratory available, while twenty-three (17.7 per cent) used two laboratories. The remaining eight (6.2 per cent) schools had three or more laboratories.

Fifty-six (43.0 per cent) of the respondents stated they scheduled a visit to a nearby planetarium, while twenty-six (20.0 per cent) visited observatories. The list of planetariums and observatories involved in the survey are listed in Appendix B.

Sixty-eight (50.4 per cent) of the respondents reported a total of 175 geological field trips, while sixty-one (45.3 per cent) had not undertaken any. Six (4.3 per cent) failed to answer the question.

While sixty-five schools (48.2 per cent) stated they had at least one telescope, fifty-three (39.2 per cent) did not have any available. Seventeen (12.6 per cent) did not respond to this area of the survey instrument. Sixty-five schools reported thirty-five different types of telescopes available. The most popular was a 4" reflecting telescope found in ten different schools. The $4\frac{1}{2}$" and 6" reflecting telescopes were available in seven schools. A complete list of the type of telescopes reported in use is found in Appendix C.

Weather stations were reported in thirty-nine (31.2 per cent) of the responding schools, while seventy-eight (62.4 per cent) did not have one. Eight (6.4 per cent) schools omitted answering this item. The weather stations in use varied from student constructed models to commercial weather stations. Several schools worked in conjunction with the local U. S. Weather Station.

Special Problems in the Implementation of Earth and Space Science Programs

The participating schools were asked to list any special problems they encountered in implementing an Earth and Space Science Program. As the responses were received, they were listed and categorized. The one hundred seventy-two respondents reported fourteen problems. These are presented in Table VIII.

The most frequently reported problem was lack of planetariums, telescopes and laboratory equipment. Other frequently reported problems

included: (1) a lack of field trips, (2) insufficient weather stations, (3) large classes, (4) inadequate time for an effective program, (5) a shortage of textbooks, both qualitative and quantitative, and (6) inadequately trained teachers. Among the less frequently reported problems were insufficient storage facilities, the prohibitive cost of materials and lack of student interest.

TABLE VIII

PROBLEMS REPORTED BY SCHOOLS IN IMPLEMENTING A SUCCESSFUL EARTH AND SPACE SCIENCE PROGRAM

Rank	Problem	Number Reporting
1	Lack of Planetariums, Telescopes and Laboratory Equipment	55
2	Insufficient Field Trips	29
3.5	Lack of Weather Stations	16
3.5	Large Classes	16
5	Insufficient Time for an Effective Program	13
6	Inadequately Trained Teachers	12
7.5	Shortage of Textbooks - Both Qualitative and Quantitative	11
7.5	Limited Laboratory Facilities	11
9	Lack of Films - Both Qualitative and Quantitative	8
10	Lack of Adequate Transportation	6
11	Lack of Nearby Planetariums and Laboratories	5
12	Insufficient Storage Facilities	4
13.5	Prohibitive Cost of Materials	3
13.5	Lack of Student Interest	3

RECOMMENDATIONS

1. School districts should make a greater concerted effort to obtain certified personnel for future vacancies as Earth and Space Science teachers.
2. Non-certified personnel presently engaged in teaching Earth and Space Science should be encouraged to increase their professional status by in-service programs, summer institutes, workshops as well as by enrolling in regular university courses.
3. Periodic review of available textbooks should be made by all personnel involved in the teaching of the program to enhance the selection of books that best meet the local needs.
4. An effort should be made by school administrators to encourage the use of laboratory facilities in the teaching of Earth and Space Science Programs.
5. Field trips should be encouraged by making provisions to have adequate transportation available for trips that contribute to the quality of the Earth and Space Science Program. Other allowances should be readily provided once a field trip has been approved.
6. All means should be exhausted to provide adequate equipment to conduct an Earth-Space Science Program. Money should be allotted in the yearly budget to purchase new equipment on a priority basis.
7. The local districts should investigate NDEA to ascertain whether equipment may be purchased cooperatively.
8. Efforts to reduce class size should be made by local administrators to encourage the development of a laboratory centered program.
9. Projects should be encouraged to provide a means of temporarily furnishing some major pieces of equipment to the local Earth and Space Program.

APPENDIX A

THE ORIGINAL QUESTIONNAIRE FORMS

Date _____

NAME _____ TITLE _____

SCHOOL _____ PHONE _____

ADDRESS _____ COUNTY _____

1. How many years has the Earth and Space Science program been taught in your school? _____

2. What grade levels is Earth and Space Science taught in your school? _____

3. How many students in your school are enrolled in the Earth and Space Science program? _____

4. How many sections of Earth and Space Science are scheduled in your school?

_____

5. How many teachers are instructing the Earth and Space Science program?

_____

6. How many teachers instructing Earth and Space Science are certified to teach the course? _____

7. What textbooks are used? If more than one, please rank -

_____(1) _____(2) _____(3)

8. How many of the Earth and Space Science classes are "laboratory centered"? (Use labs extensively) _____

9. How many laboratories are used for Earth and Space Science instruction?

_____

10. What are your special problems that stand in the way of successful implementation of the Earth and Space Science course?

a.

b.

c.

d.

e.

11. Have you scheduled your Earth and Space Science classes to visit a planetarium? Yes_____ No_____ Where_____

12. Have you scheduled your classes to visit an observatory? Yes____ No____

13. What size and type of telescope(s) is used in your Earth and Space Science program? _____

14. How many geology field trips are usually scheduled per section per year (average)? _____

15. Does your Earth and Space Science class(es) have use of a weather station? _____

What type? _____

ADDITIONAL COMMENTS: -

Please return the completed form to: -

Dr. John E. Kosoloski
Coordinator, Earth and Space Science
Department of Public Instruction
Harrisburg, Pennsylvania 17126

APPENDIX B

PLANETARIUMS AND OBSERVATORIES VISITED BY

EARTH AND SPACE SCIENCE CLASSES

Planetariums and Observatories Visited by Earth and Space Classes

Reading Public Museum (Reading, Pa.)

Franklin and Marshall

Fels (Philadelphia)

Buhl (Pittsburgh)

Allegheny Observatory

Penn State University

North Museum (Lancaster)

Cedar Cliff High School (Camp Hill)

Dickinson College

Sproul Observatory - Swarthmore College

Villanova University

Erie Museum Planetarium (Erie, Pa.)

May Aug Museum

Bucknell University Observatory

New Kensington Junior High School

Erie Planetarium

Lower Merion

APPENDIX C

TYPES OF TIMESAVERS EMPLOYED BY SKILLED

DESCRIPTIONS AND EXAMPLES